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(19) (CA) **APPLICATION FOR CANADIAN PATENT** (12)

(54) Apparatus for Syncronizing Movement of a Shiftable Member

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Notice: This application is as filed and may therefore contain an incomplete specification.

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# APPARATUS FOR SYNCHRONIZING MOVEMENT OF A SHIFTABLE MEMBER

## Field of the Invention

This invention relates to movement synchronizing apparatus, and will have application to equalizers used to synchronize end-to-end linear movement of a shiftable frame.

## Background of the Invention

Synchronizing devices, also known in the trade as equalizers, are useful devices for ensuring corresponding movement of one or more shiftable members relative to a stationary member. These devices have been used previously with success in the recreational vehicle field, particularly in the slide-out room industry. Since it is desirable to synchronize the end-to-end movements of the sliding frame which supports the slide-out room, various equalizers have been developed. Several equalizers of this type are shown in our pending U.S. Patent 5,295,430, which is incorporated herein by reference, and in the references cited during prosecution of that application.

Most of the prior equalizers are limited in usefulness due to their elements and their positioning requirements. Our prior invention requires the use of pulleys and cables which are attached to a protrusion of the slide-out room support tube. Many of the other equalizers requires complex mechanical arrangements which limit their versatility and add to the cost of the units.

## Summary of the Invention

The equalizer of this invention is of simple, versatile and economical construction. The equalizer may be adapted for use with almost any application which includes a sliding member shifting relative to a stationary member.

The equalizer generally includes a cable or cables and two or more tensioning members, preferably rotatable grooved pulleys. The tensioning members are axially fixed to one of the stationary or shiftable members. The cable or cables extend across the tensioning members and are attached to



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opposite sides of the other of the stationary or shiftable member. In this fashion, linear movement of the shiftable member is synchronized from side-to-side due to the constant biasing effect of the fixed length cables and the axial fixing of the tensioning pulleys.

The equalizer of this invention is very suitable for use in the recreational vehicle industry, with particular importance in slide-out room RVs. By connecting the equalizer to the slidable and stationary frames of the RV, side-to-side linear movement of the slide-out room is synchronized, thus saving wear and tear on the RV unit and on the drive train, as well as preventing a freeze up of the sliding frame.

Accordingly, it is an object of this invention to provide for a novel and improved equalizer for sliding members.

Another object is to provide for an equalizer which is adaptable for use in slide-out room RVs.

Another object is to provide for a linear movement equalizer which is of simple and economical construction.

Another object is to provide for an equalizer which can be easily installed into either new units or can be adapted to retrofit existing units.

Other objects will become apparent upon a reading of the following description.

## Brief Description of the Drawings

The preferred embodiments of the invention have been depicted for illustrative purposes only and are not to be considered as limiting the invention in any way.

Fig. 1 is a top plan view of a first embodiment of the equalizer of this invention.

Fig. 2 is a side elevation view of the equalizer of Fig. 1.

Fig. 3 is a top plan view of a modified equalizer showing stacked tensioning pulleys.

Fig. 4 is an end elevation view of the equalizer of Fig. 3.

Fig. 5 is a top plan view of the equalizer of Fig. 3 showing the tensioning cable attached directly to sliding tubes that support a slide out room of a recreational vehicle.

Fig. 6 is a top plan view of another embodiment of the equalizer.

Fig. 7 is a top plan view of an equalizer similar to that of Fig. 5 but used on a tube supported recreational vehicle slide-out room.

Fig. 8 is a top plan view of another embodiment of the equalizer of the present invention.

## Description of the Preferred Embodiments

The preferred embodiments herein described are not intended to be exhaustive or to limit the invention to the precise forms disclosed. They are chosen and described to explain the principles of the invention and its application and practical use to best enable others skilled in the art to follow its teachings.

Referring first to Figs. 1 and 2, reference numeral 10 refers generally to the equalizer or synchronizing apparatus of this invention. Equalizer 10 is used in conjunction with a frame 12 which is shiftably associated with stationary frame 14. For purposes of this invention, frames 12 and 14 may be physically connected to each other, either directly or indirectly, or may be simply oriented in close proximity with no physical connections therebetween. Frame 12 is shiftable in a linear fashion relative to frame 14, which is normally fixed or stationary.

Equalizer 10 includes a first tensioner including pulleys 16 and 18, a second tensioner including pulleys 17 and 19, and a pair of cables 20 and 22. Pulleys 16-19 are connected to stationary frame 14 as by shafts 26, 27, 28 and 29 respectively, with each pulley freely rotatable about its connecting shaft. Pulleys 16-19 are of similar or identical construction. Each pulley 16, 17, 18, 19 has a continuous circumferential outer groove 30, 31, 32, 34 respectively. Pulleys 16, 17 are located adjacent to a side edge 24 of stationary frame 14 with pulleys 18, 19 located adjacent the opposite side edge 25 of the stationary frame. Pulleys 16, 17 and 18, 19 may be longitudinally and transversely aligned or may be of the offset configuration shown in Figs. 1 and 2.

Cables 20 and 22 are formed from any suitable material of sufficient strength to withstand the forces exerted on the cables during movement of the shiftable frame 12. Cable 20 is attached at one end 21 to shiftable frame 12 adjacent side edge 24 and end edge 36. Cable 20 extends across pulley 16 and pulley 18 and rides freely in grooves 30, 32. Cable 20 has its other end 23 attached to shiftable frame 12 adjacent side edge 25 and end edge 38.

Cable 22 is attached at one end 40 to shiftable frame 12 adjacent side edge 25 and end edge 36. Cable 22 extends across pulley 17 and pulley 19 and rides freely in grooves 31, 34. The other end 42 of cable 22 is connected to movable frame 12 adjacent side edge 24 and end edge 38. Cables 20 and 22 may be directly connected to frame 12 in a common manner or may be connected to the shiftable frame as by tension adjusting devices such as turnbuckles or threaded cable ends and tensioning nut generally indicated at 46.

When connected to shiftable frame 12, cables 20 and 22 should be taut with little or no slack in order for the cables to move correspondingly with the shiftable frame. Pulleys 16-19 are axially fixed and are freely rotatable about their connective shafts 26-29. Common rotation enhancers such as bushings, sleeves or bearings (not shown) may be employed to facilitate free rotation of the pulleys 16-19.

Shiftable frame 12 is preferably designed for connection to a common drive means (not shown) and shifts in a linear fashion relative to stationary frame 14. By virtue of the opposite diagonal corner connections of cables 20, 22 as above described, frame 12 will shift relative to frame 14 in an equalized or synchronous manner, that is the distance traversed by side edge 25. Should slack develop in one of the cables 20 or 22, that cable can be tightened by adjusting turnbuckle 46, or like devices. Of course, the frame 14 upon which the pulleys 16-19 are mounted may be made the movable frame and the frame 12 upon which the cables are attached made the stationary frame, with the equalizer 10 functions in the same way as described. While the pulleys have been described as being mounted on the stationary frame and the ends of the cables have been described as being secured to the movable frame, one skilled in the art will recognize that the stationary and movable frames may be

reversed; that is, the pulleys may be mounted on the movable frame and the cables secured to the stationary frame.

Figs. 3 and 4 illustrate a modified equalizer 50. Equalizer 50 also operates to synchronize the linear movement of frame 52 relative to stationary frame 54 as described above. Equalizer 50 includes pulleys 56 and 58 which are connected to frame 54 as by fixed shafts 60, 62 respectively. Pulleys 56, 58 are freely rotatable about shafts 60, 62 and have continuous circumferential grooves 64, 65 and 66, 67 respectively as shown. For purposes of this invention pulley 56 may be a single pulley with spaced grooves 64, 65 or may consist of two grooved pulleys (not shown) stacked on shaft 60. Similarly, pulley 58 may be a single pulley with spaced grooves 66, 67 or may consist of two grooved pulleys (not shown) stacked on shaft 62.

Cable 68 is connected at one end 69 adjacent to corner 53 of frame 52. Cable 68 extends across pulleys 56 and 58 in grooves 64, 66 and has its opposite end 70 connected to frame 52 adjacent corner 55. Cable 72 is connected at end 73 to frame 52 adjacent corner 51 and extends across pulleys 56, 58 in grooves 65 and 67. Cable 72 has its other end 74 connected to frame 52 adjacent corner 57. Cables 68, 72 are stretched taut and preferably define a criss-cross arrangement between pulleys 56 and 58 as shown. The operation of equalizer 50 is the same as that of equalizer 10.

In the embodiment shown in Fig. 5, support tubes 86, 87 are connected to a stationary frame (not shown) and underlie movable frame 82. Tubes 88, 89 are telescopically fitted in each tube 86, 87 and are connected in a common manner to frame 82. Drive means (not shown) is operably connected to either the frame 82 or the tubes 88, 89 and serves to shift the movable frame 82 and the room (not shown) between the extended and retracted positions.

Pulleys 56 and 58 are connected to tubes 86, 87 as by shafts 60, 62 as described above. Cable 68 has its end 69 connected to the inner end of tube 88 and extends across pulley grooves 65, 67 with its opposite end 74 connected to the inner end of tube 89. A cable 72 has its end 75 connected to end of tube 88 opposite the bar at which cable 68 is connected at end 69, and cable 72 has its other end 77 connected to the end of tube 89 opposite the end at which cable 28 is connected. Alternatively, cables 68 and 72 may have their

ends connected directly to the movable frame 82. Alternatively, pulleys 56, 58 may be connected to the movable frame 82 or the movable tubes 88, 89 with cables 68, 72 having their ends 69, 74 and 75, 77 connected to the stationary frame or stationary tubes 86, 87. The sliding of frame 82 relative to frame 76 and the function of equalizer 50 is as described above.

Returning now to Figs. 6 and 7, elements in Fig. 6 which are the same or substantially the same as those in the embodiment of Fig. 1 and 2 retain the same reference symbol but increased by 200; elements in the embodiment of Fig. 7 which are the same or substantially the same as corresponding elements in the embodiment of Figs. 1 and 2 contain the same reference numerals but increased by 300. In the embodiment of Fig. 6, the movable frame 212 moves between the pulleys 216, 217 and 218, 219, which pulleys are arranged in a quadrilateral arrangement and located respectively at the corners of frame member 290, 292 which are both secured to the stationary frame 214. Accordingly, movement of the movable frame 212 is limited by its engagement with the pulleys. Of course, the pulleys may be mounted on movable frame 212 and the ends 221, 223 and 240, 242 of the cables 220, 222 attached to the stationary member, with the equalizer 210 functioning in exactly the same way. In the embodiment of Fig. 7, tubes 390, 392 are secured to the stationary frame 314, and are telescopically received by slidable tubes 394, 396 which are slidably mounted on the tubes 390, 392 respectively. The movable frame (not shown) is secured to the tubes 394, 396. The pulleys 316, 317, 318 and 319 are mounted on opposite ends of the tubes 390, 392 respectively, with each of the cables being wrapped around a diagonally opposite pulley and crossing the other cable at a point between the tubes 390, 392. The embodiment of Fig. 7 operates in the same way that the embodiment of Figs. 1-2 and Fig. 6 operate, as discussed above.

Referring now to the embodiment of Fig. 8, elements the same or substantially the same as those of the embodiment of Figs. 1 and 2 retain the same reference character, but increased by 400. In the embodiment of Fig. 8, stationary tubes 480, 482 are fixed to stationary frame 414 and slidably received slide tubes 484, 486, which are connected to a movable frame (not shown) by connecting plates 488, 490. The end 442 of the cable 422 and the

end 421 of the cable 420 are both connected to the opposite sides of the plate 490, and the end 423 of cable 420 and the end 440 of cable 422 are both connected to opposite sides of the plate 488. Thus it can be seen from Fig. 8, the cable 420 is wrapped around the pulleys 416 and 418 and also is wrapped about a third pulley 492. Similarly, the cable 422 is wrapped around the pulleys 417 and 419 and is also wrapped around a third pulley 494. The third pulleys 492 and 494 wrap their respective cables around the fixed tubes 480 and 482, and also assure that the pulley forces exerted by the cables are applied along the axis of the tubes 484 and 486. The embodiment of Fig. 8 operates in the same way as the embodiment of Fig. 1 and 2 as discussed above, wherein equalizing forces are transmitted through the movable frame through the tubes 484 and 486 as the movable frame is moved.

It should be noted that all embodiments of the equalizer operate in similar fashion to synchronize linear movement of a movable member relative to a stationary member. By maintaining constant tension on the cables used in each equalizer, the pulling effect created by the routing of the cables in each equalizer serves to apply roughly equal force to both sides of the movable frame (or both slide tubes) to allow relatively identical travel distances regardless of the location of the drive means. The equalizers shown represent only a small cross-section of the configurations and routings possible and are not to be considered as limiting this invention to any precise structure. Such limitations on the scope of this invention can only be found by referring to the language of the following claims.

THE EMBODIMENTS OF THE INVENTION IN WHICH AN EXCLUSIVE PROPERTY OR PRIVILEGE IS CLAIMED ARE DEFINED AS FOLLOWS:

1. Apparatus for synchronizing movement of a movable member relative to a stationary member comprising:

a stationary member and a movable member shiftable relative to the stationary member;

a first tensioner connected to one of said members;

a second tensioner connected to said one member and spaced from said first tensioner; and

a pair of cables, one of said cables being connected to the other movable member and extending across said first and second tensioners, the other cable being connected to said other member at spaced locations from said first cable, said second cable extending across said first and second tensioners.

2. Apparatus as claimed in claim 1, wherein said first tensioner includes one pair of pulleys and said second tensioner includes another pair of pulleys, said one member having a pair of side edges, said one pair of pulleys being mounted adjacent one of said side edges, the other pair of pulleys being mounted adjacent the other side edge.

3. Apparatus as claimed in claim 2, wherein each of said cables is wrapped around one pulley of each of said pairs of pulleys and the other cable is wrapped around the other pulley of each of said first and second pairs of pulleys.

4. Apparatus as claimed in claim 1, wherein said one member is the stationary member and the other member is the movable member.

5. Apparatus as claimed in claim 1, wherein said first and second tensioners each include a pulley having a pair of coaxial grooves, each of said cables being wrapped around one groove on each pulley.

6. Apparatus as claimed in claim 5, wherein said one member has a pair of side edges, the pulley of one of said tensioners being mounted adjacent one of said side edges, the pulley of the other pair of tensioners being mounted adjacent the other side edge.

7. Apparatus as claimed in claim 2, wherein each of said cables has a pair of opposite ends, one end of each of said cables being secured to the

other member adjacent one side edge of said one member, the other end of each said cable being secured to the other member adjacent the other side edge of said one member.

8. Apparatus as claimed in claim 1, wherein a first pair of support tubes are mounted on said one member and a second pair of support tubes are mounted on the other member, each of said first pair of support tubes telescopingly receiving a corresponding one of the other pair of support tubes.

9. Apparatus as claimed in claim 2, wherein the pulleys comprising each tensioner are mounted on said one member in a quadrilateral arrangement wherein the other frame moves between the pulleys of each tensioner, each of said cables being wrapped around an diagonally opposite pulley and crossing the other cable at a point between the tensioners.

10. Apparatus as claimed in claim 9, wherein a first pair of support tubes are mounted on said one member and a second pair of support tubes are mounted on the other member, each of said first pair of support tubes telescopingly receiving a corresponding one of the other pair of support tubes, each of said pulleys being mounted adjacent opposite ends of each of one of said pairs of said support tubes.

11. Apparatus as claimed in claim 1, wherein a first pair of support tubes are mounted on said one member and a second pair of support tubes are mounted on the other member, each of said first pair of support tubes telescopingly receiving a corresponding one of the other pair of support tubes, each of said tensioners including a third pulley located between said pair of pulleys for guiding the corresponding cable around said tubes.

12. Apparatus as claimed in claim 11, wherein one end of each cable is attached to an end of one of said support tubes.

13. Apparatus for synchronizing linear movement of a shiftable member relative to a stationary member comprising:

a stationary member and a shiftable member;

a first tensioner connected to one of said members;

a second tensioner connected to said one member and spaced from said first tensioner;

the other member having a first side edge and a second side edge;

a first cable having a first end connected to said other member adjacent said first side edge, said first cable extending across said first and second tensioners and having a second end connected to said other member adjacent said second side edge; and

a second cable having a first end connected to said other member adjacent said second side edge, said second cable extending across said second and first tensioners and having a second end connected to said other member adjacent said first side edge.

14. Apparatus for synchronizing linear movement of a shiftable member relative to a stationary member comprising:

a stationary member and a shiftable member;

a first pulley connected to one of said members;

a second pulley connected to said one member and spaced from said first pulley;

a third pulley connected to said one member and spaced from said first and second pulleys;

a fourth pulley connected to said one member and spaced from said first, second and third pulleys wherein the four pulleys are in a quadrilateral arrangement;

a first cable extending across said first and third pulleys and having a first end connected to the other of said members at a point between said first and second pulleys, said first cable having a second end connected to said other member at a point between said third and fourth pulleys; and

a second cable extending across said second and fourth pulleys and having a first end connected to said other member adjacent to said first cable first end, said second cable having a second end connected to said other member adjacent said first cable second end, wherein linear movement of said shiftable member relative to said stationary member is synchronized.

15. Apparatus of Claim 13 wherein said first tensioner includes first and second spaced rotatable pulleys, said second tensioner includes third and

fourth rotatable pulleys, said first cable extending across said first and third pulleys, said second cable extending across said second and fourth pulleys.

16. Apparatus of Claim 15 wherein each pulley has a pair of peripheral grooves, said first and second cables fitted in said corresponding pulley groove.

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Abstract of the Disclosure

A device for synchronizing the linear movement of a shiftable member relative to a stationary member. The drive includes two or more rotatable tensioning pulleys and one or more cables. The pulleys are connected to one of the stationary or shiftable members with the cable or cables extending across the pulleys and connected to the other of the stationary or shiftable members. One of the particular areas of use for the device is in the recreational vehicle slide out room field.



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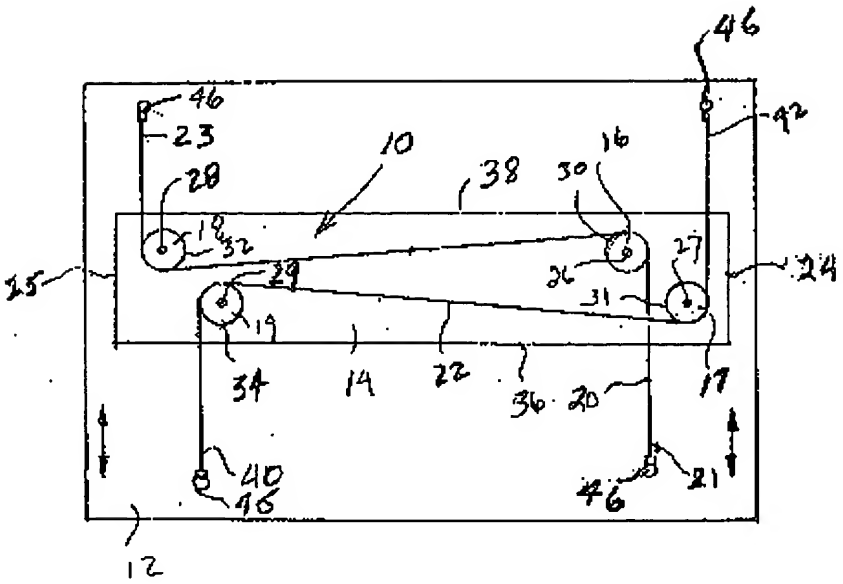


Fig 1

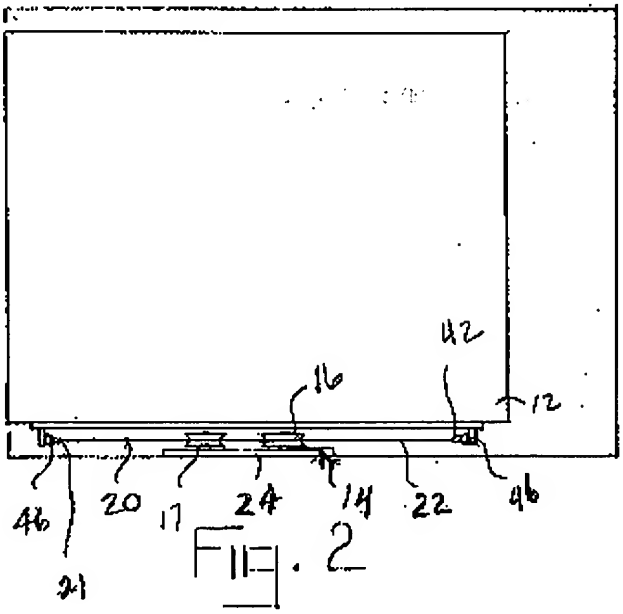


Fig. 2

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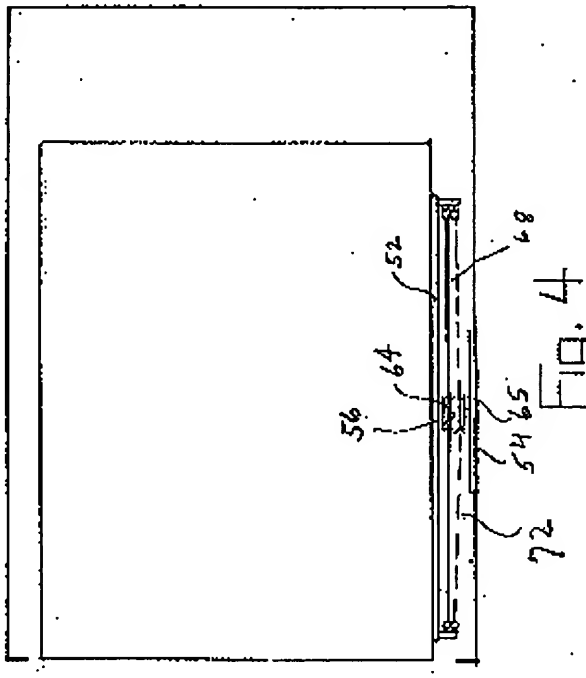


FIG. 4

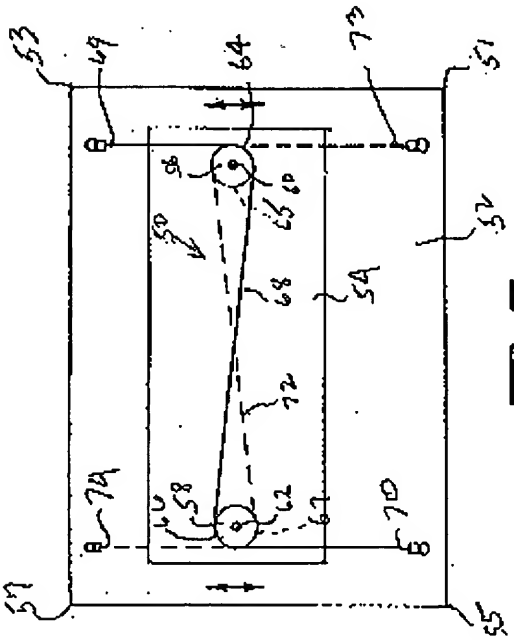


FIG. 3

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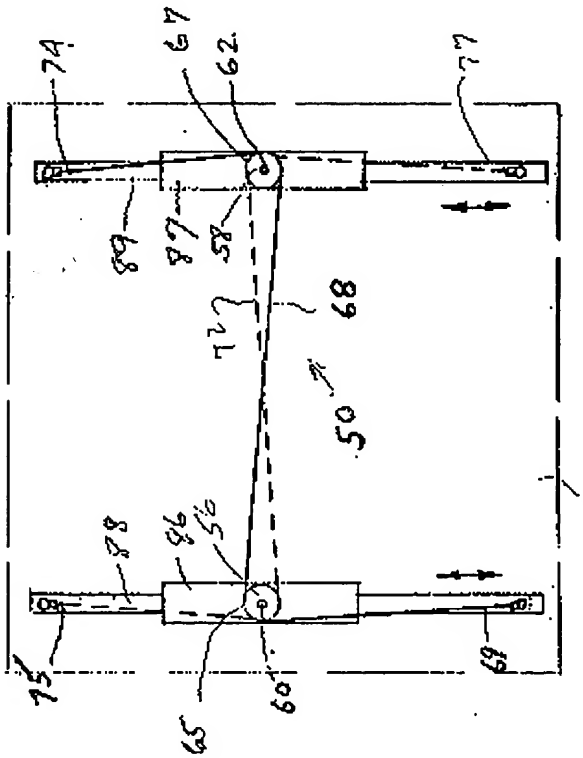


FIG. 5

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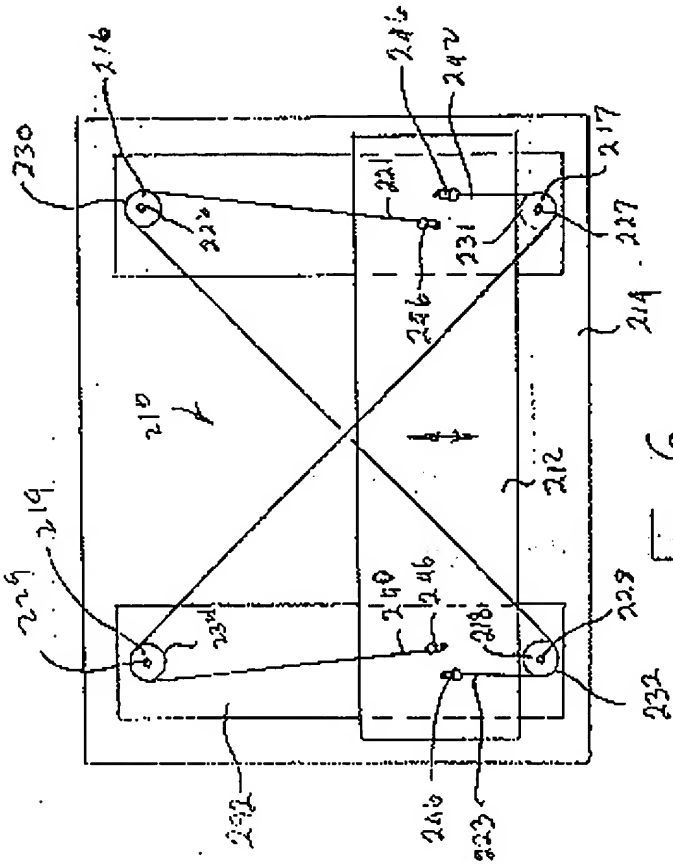


FIG. 6

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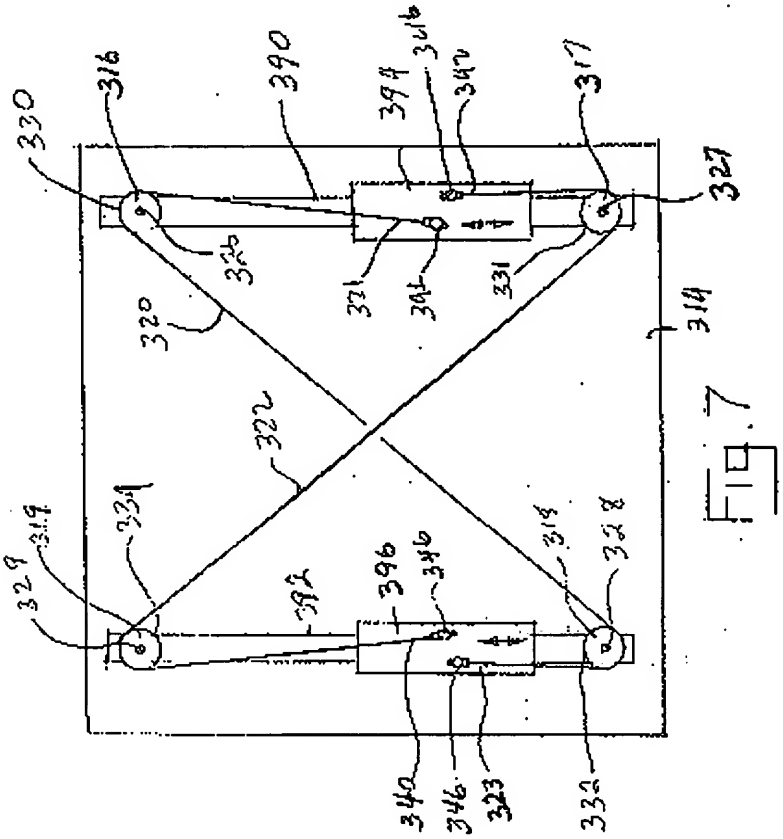


FIG. 7

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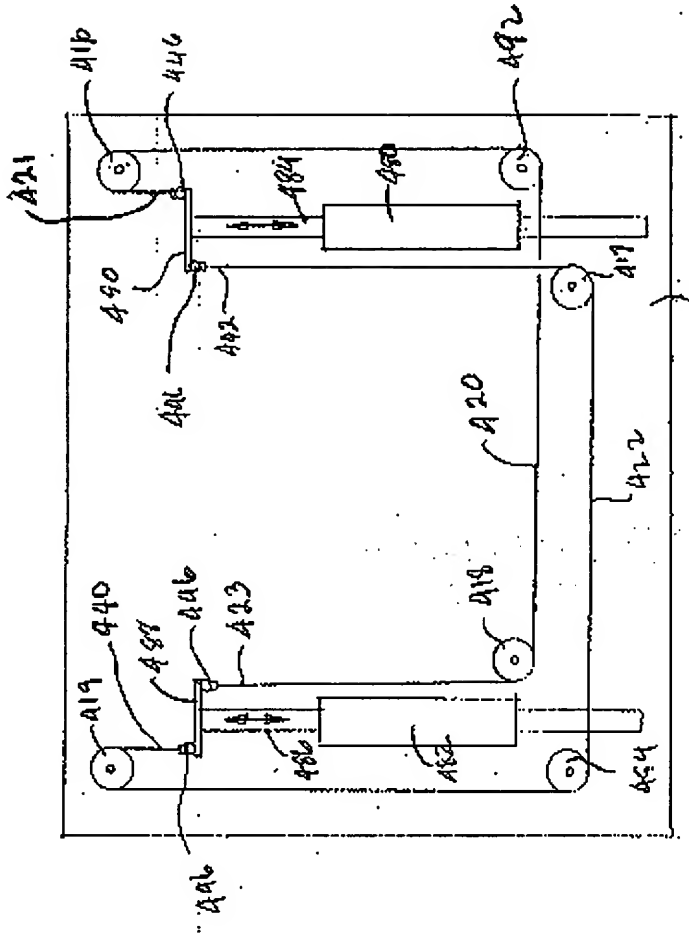


FIG. 8

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